

CHARGING SYSTEM

SERVICE TOOLS

Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	258–259

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
ELECTRO SPECIALTIES BATTERY LOAD TESTER.....	710	262
EXTECH INDUCTIVE AMMETER	380941	258

GENERAL

SYSTEM DESCRIPTION

The purpose of the charging system is to maintain the battery at a full state of charge and to provide the electrical system with the required electrical power for normal vehicle operation.

Magneto

The magneto is the primary source of electrical energy. It transforms a magnetic field into an electric current (AC).

The magneto has a 3 phase delta wound stator.



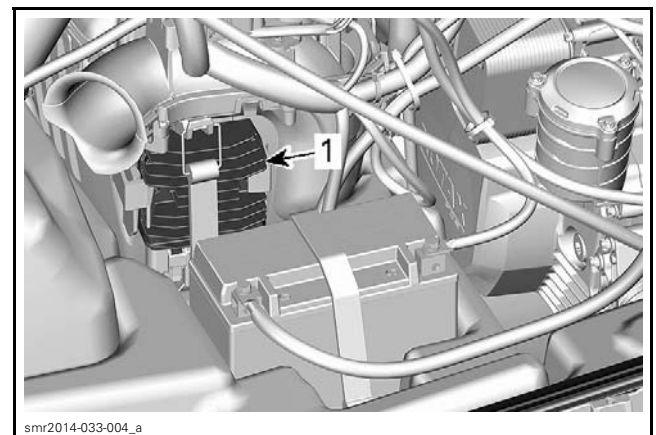
TYPICAL

Voltage Regulator/Rectifier

The rectifier receives AC current from the magneto and transforms it into direct current (DC).

The voltage regulator, included in the same unit, limits voltage to a maximum level to prevent any damage to electrical components.

The voltage regulator is located on the LH side of the air intake silencer, behind the battery.



1. Voltage regulator/rectifier

Battery

The battery supplies DC power to the electric starter for cranking the engine. During engine starting, it also supplies DC power to every electrical and electronic system in the vehicle as well as all accessories.

At low engine RPM operation and high current load conditions, it supplements the magneto output and helps to maintain a steady system voltage.

INSPECTION

CHARGING SYSTEM OUTPUT

First ensure that battery is in good condition prior to performing the following tests.

NOTE: It is good practice to check for fault codes using the B.U.D.S. as a first troubleshooting step. Refer to *DIAGNOSTIC SYSTEM AND FAULT CODES* subsection.

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Subsection 03 (CHARGING SYSTEM)

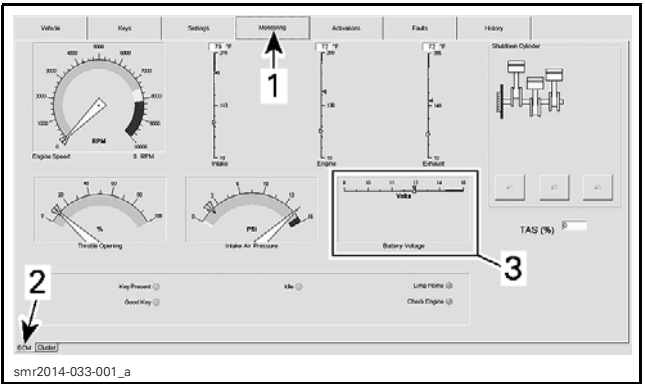
When performing charging system tests, if the watercraft is out of water, link a garden hose to the exhaust system. Refer to EXHAUST SYSTEM FLUSHING in the PERIODIC MAINTENANCE PROCEDURES subsection.

- NOTICE When watercraft is out of water:
- Never run engine without supplying water to the exhaust system.
 - Never run engine longer than 2 minutes.

Output Voltage Test Using B.U.D.S.

- 1. Connect to the latest applicable B.U.D.S. software. Refer to COMMUNICATION TOOLS AND B.U.D.S. subsection.
- 2. Select the Monitoring and ECM tabs.
- 3. Start engine.
- 4. Increase engine RPM as specified in the following table and read voltage in B.U.D.S.

Table with 2 columns: TEST ENGINE SPEED, VOLTAGE (DC). Row 1: 5500 RPM, 14.5 ± .5 Vdc



TYPICAL
1. Monitoring tab
2. ECM tab
3. Battery voltage

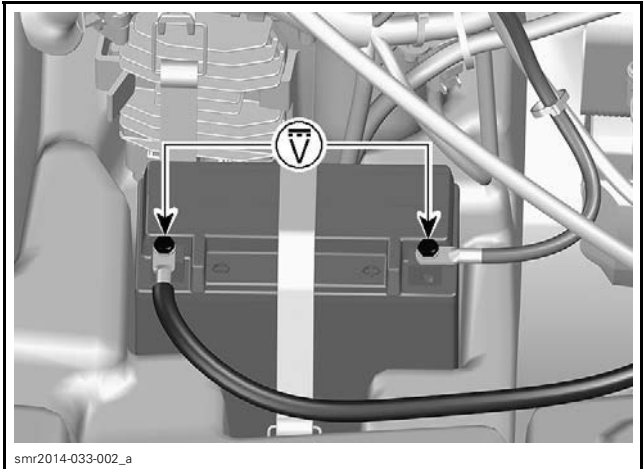
If voltage is above specification, replace voltage regulator/rectifier.
If voltage is below specification, check stator output and wiring harness prior to concluding that voltage regulator/rectifier is defective. Refer to MAGNETO AND STARTER subsection.

Output Voltage Test Using a Multimeter

Table with 1 column: REQUIRED TOOL. Row 1: FLUKE 115 MULTIMETER (P/N 529 035 868)

For battery access, refer to BATTERY ACCESS in this subsection.

- 1. Set multimeter to Vdc.
- 2. Connect multimeter to battery posts.



TYPICAL - CHARGING SYSTEM VOLTAGE TEST AT BATTERY POSTS

- 3. Start engine.
- 4. Increase engine RPM as specified in the following table and read voltage with the multimeter.

Table with 2 columns: TEST ENGINE SPEED, VOLTAGE (DC). Row 1: 5500 RPM, 14.5 ± .5 Vdc

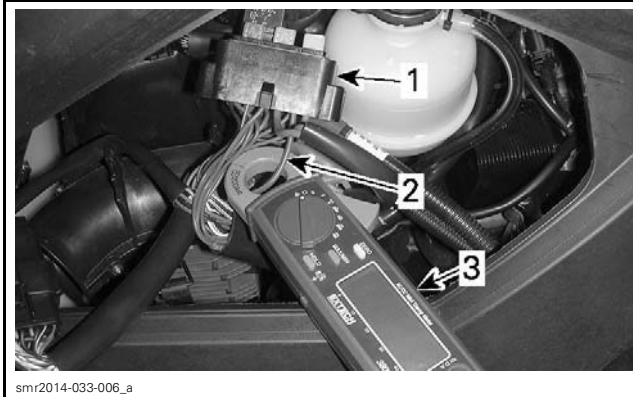
If voltage is above specification, replace voltage regulator/rectifier.
If voltage is below specification, check stator output and wiring harness prior to concluding that voltage regulator/rectifier is defective. Refer to MAGNETO AND STARTER subsection.

Output Current Test with an Inductive Ammeter

Table with 1 column: REQUIRED TOOL. Row 1: EXTECH INDUCTIVE AMMETER (P/N 380941)

- 1. Through the LH access opening, detach fuse box from its support.
- 2. Turn on the ammeter and select 40 Adc.
- 3. From underneath the fuse box, clamp the ammeter around the DC output wire.

DC OUTPUT WIRE IN FUSE BOX
Terminal C2 (RED/BLACK wire)



1. Fuse box
2. DC output wire
3. Ammeter clamp

NOTE: Zero set the ammeter before use or reading may be erroneous.

4. Start engine.
5. Increase engine RPM as specified in the following table and read current with the ammeter.

TEST ENGINE SPEED	CURRENT
5500 RPM	Approx. 7-8 A

NOTE: Initial current reading will be higher than specified due to the battery drain from the engine start. This is an indication that the charging system is operating normally. Current load will come down as the battery recovers its charge.

If current reading is far below specification, test stator output and wiring harness prior to concluding the voltage regulator/rectifier is faulty.

NOTE: If the battery is in poor condition or is not at a full state of charge, current reading will be above specification. Refer to *BATTERY* in this subsection for battery testing.

6. Secure fuse box to its support.

Output Current Test with a Multimeter

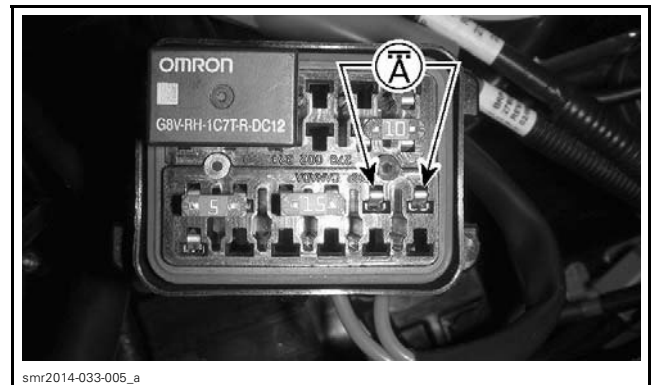
REQUIRED TOOL
FLUKE 115 MULTIMETER (P/N 529 035 868)



NOTICE Charging current may rise over multimeter current reading capacity (usually 10 A) possibly causing test equipment damage. It is preferable to use an inductive ammeter to test the charging system current.

1. Through the LH access opening, remove fuse box cover.
2. Remove charging system fuse F4.
3. Set multimeter to Adc.
4. Connect probes to fuse holder terminals.

NOTICE Probe terminals by touching (NOT inserting) terminals lock tabs.



CHARGING SYSTEM FUSE REMOVED

5. Start engine.
6. Increase engine RPM as specified in the following table and read current with the multimeter.

OUTPUT CURRENT TEST	
TEST ENGINE SPEED	CURRENT (DC)
5500 RPM	Approx. 10 A

NOTE: Initial current reading will be higher than specified due to the battery drain from the engine start. This proves the charging system works. Current load will come down as the battery recovers its charge.

If current is below specification, carry out a *STATOR OUTPUT VOLTAGE TEST* prior to concluding the voltage regulator/rectifier is faulty.

TROUBLESHOOTING

DISCHARGED OR WEAK BATTERY

1. Battery posts and/or cable terminal oxidized.
 - Clean battery terminals, posts, and coat with dielectric grease.

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2. Loose or bad connections.
 - Check for wiring and connector tightness, frayed or broken wires. Repair or replace cables or connectors.
3. Worn or faulty battery (sulfated, fretting, shorted plates or cell, damaged casing, loose post).
 - Carry out a BATTERY VOLTAGE TEST (LOAD APPLIED).
 - Replace battery.
4. Burnt fuse) or faulty rectifier.
 - First check fuse. If in good condition, check voltage regulator/rectifier.
5. Faulty stator.
 - Test stator and replace as required.
6. Parasitic or "Key Off" current loads.
 - Isolate, reduce or eliminate such loads.
 - Recharge battery as recommended if vehicle is not used for extended periods of time.

NOTE: "Key Off" or parasitic loads may be loads due to installed accessories. Parasitic loads may also be due to water infiltration in connectors, or partial short circuits that slowly drain a battery without causing a fuse to burn.

LOW OR NO CHARGING SYSTEM VOLTAGE

1. Blown F4 fuse.
 - Check F4 fuse.
2. Defective stator.
 - Test stator. Refer to MAGNETO AND STARTER subsection.
3. Defective charging system wiring or connections.
 - Check for damaged wiring.
 - Check for damaged or loose connections.

REPETITIVE BLOWN F4 FUSE

1. Battery not connected.
 - Connect battery.
2. Voltage regulator/rectifier internal circuit shorted to ground.
 - Refer to VOLTAGE REGULATOR/RECTIFIER TEST FOR BLOWN F4 FUSE in this subsection.

PROCEDURES

VOLTAGE REGULATOR/RECTIFIER

Voltage Regulator Continuity Test

Due to internal circuitry, there is no static test available to check continuity.

Voltage Regulator/Rectifier Access

Remove the LH access cover.

Disconnect the steering connector.

Detach fuse box from its support.

Voltage Regulator/Rectifier Test for Blown F4 Fuse

1. Detach the voltage regulator/rectifier from the electrical component support. Refer to *VOLTAGE REGULATOR/RECTIFIER REMOVAL* in this subsection.
2. Disconnect the voltage regulator/rectifier 2-wire connector.
3. Install a new fuse.

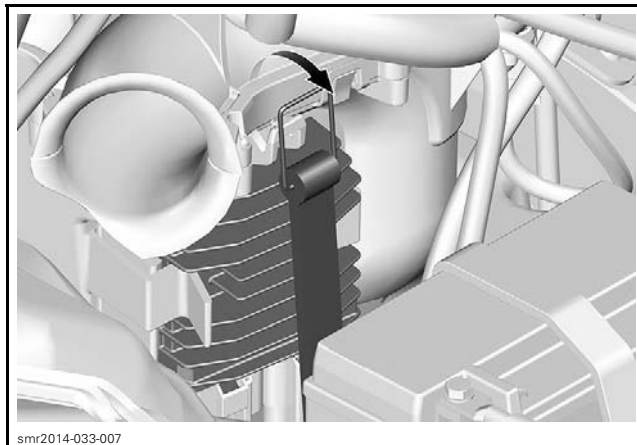
If the fuse still burns, check for a shorted wire or connector pin.

If fuse does not burn, replace regulator/rectifier.

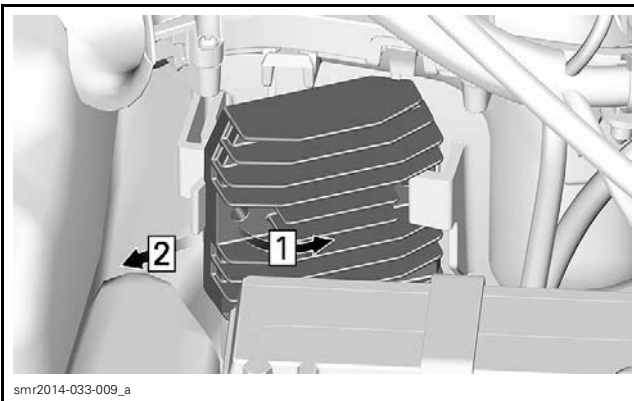
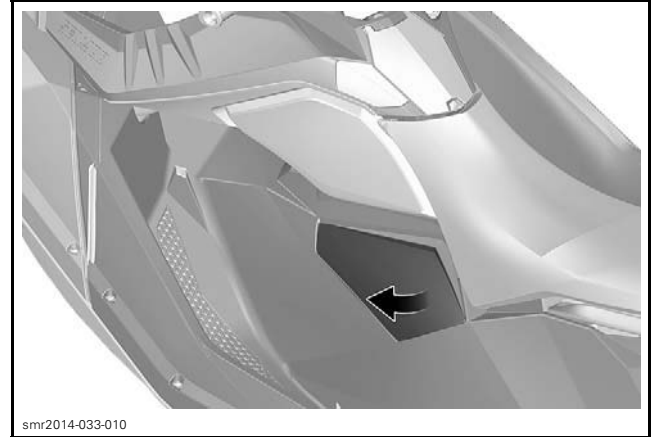
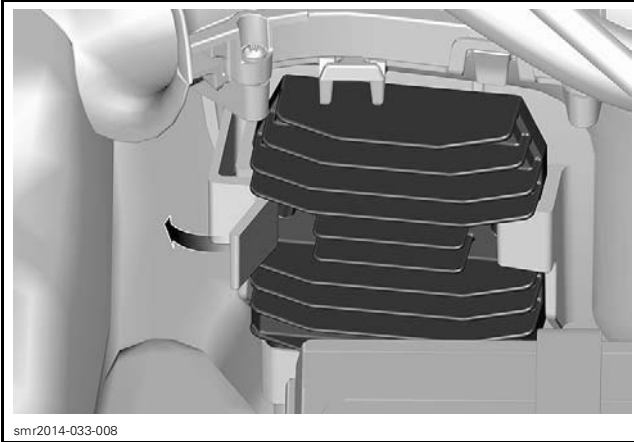
Voltage Regulator/Rectifier Replacement

Voltage Regulator/Rectifier Removal

Detach the retaining strap.



Push the support locking tab and remove voltage regulator/rectifier from its support.



Voltage Regulator/Rectifier Installation

Installation is the reverse of the removal procedure.

Reinstall remaining removed components.

BATTERY

Battery Information

The battery is a VRLA (Valve Regulated Lead Acid) maintenance free and non-spillable. It never need electrolyte level check, readjustment and refilling, however, they still need periodic charging.

- This battery is factory filled and activated.
- It requires an initial charging to ensure proper operation and maximum life span.

Battery Access

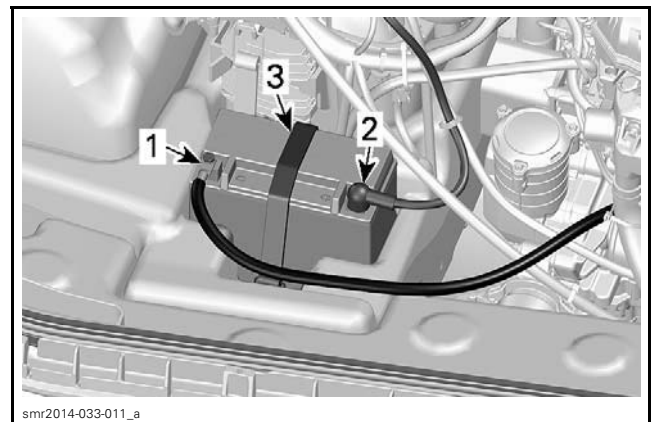
Remove the LH access cover.

Battery Removal

⚠ WARNING

The BLACK (-) battery cable must always be disconnected first and reconnected last. Never charge or boost battery while installed in watercraft.

1. Disconnect the BLACK (-) battery cable.
2. Slide the RED rubber protector off the RED (+) cable terminal and disconnect it from the battery post.
3. Reinstall bolts to secure retaining nuts during removal.
4. Detach retaining strap.



CENTRAL BODY REMOVED FOR CLARITY PURPOSE

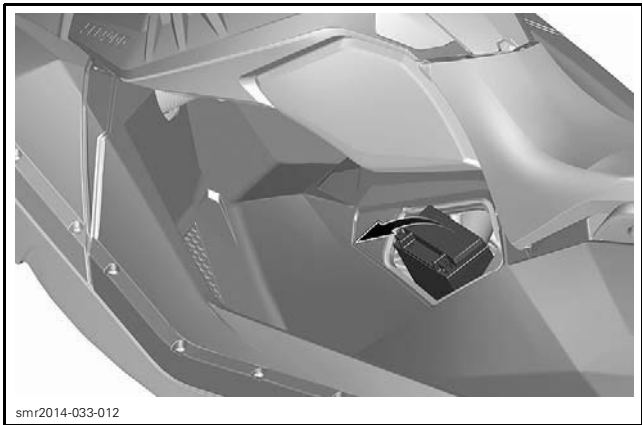
1. BLACK (-) cable
2. RED (+) cable
3. Retaining strap

5. Remove battery from vehicle.

NOTICE Should any electrolyte spillage occur, immediately wash off area with a solution of baking soda and water, then rinse thoroughly.

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Battery Cleaning

Clean the battery casing, cables and battery posts using a solution of baking soda and water.

Remove corrosion from battery cable terminals and battery posts using a firm wire brush.

Battery top should be cleaned with a soft brush and any grease-cutting soap or baking soda solution.

Rinse with clear water then dry well.

Battery Inspection

Visually inspect battery casing for cracks, leaks or other possible damages.

Discoloration, warping or raised top, indicates that the battery has overheated or been overcharged.

If the casing is damaged, replace battery and thoroughly clean battery tray and surrounding area with a water and baking soda solution.

⚠ CAUTION Should the battery casing be damaged, wear a suitable pair of non-absorbent gloves when removing the battery by hand.

Inspect the battery posts for security of mounting.

Battery Testing

There are 3 types of battery tests.

TEST METHOD	COMMENT
Voltage test (load applied)	A dynamic voltage test with a load applied gives an accurate indication of the condition of the battery. This is the most recommended method.
Voltage test (no load)	A static voltage test is carried out without discharging current. It is the simplest and most commonly used but the most likely to give false results.
Battery electrolyte reading	Gives an accurate indication of the charge condition of each cell.

Battery Voltage Test (Load Applied)

Use a load testing device such as the ELECTRO SPECIALTIES BATTERY LOAD TESTER (P/N 710). It has a 500 A carbon pile adjustable load.

Follow battery load tester instructions.

Apply a load of 3 times the ampere-hour rating of the battery for 14 seconds, then check battery voltage.

BATTERY VOLTAGE TEST (LOAD APPLIED)	
TIME TO MEASURE INTO TEST	VOLTAGE (WITH LOAD APPLIED)
14 seconds	10.5 Vdc min.

If battery voltage has dropped below specification, the battery storage capacity has decreased appreciably and the battery should be replaced.

Battery Voltage Test (No Load)

NOTE: Be aware that the voltage test can indicate that the battery is in good condition even though the battery does not have enough stored energy to crank the engine. A load test gives a more accurate indication of the condition of the battery.

If the battery has just received a charge, wait 1-2 hours before taking a voltage reading.

Set multimeter to Vdc and measure voltage at battery terminals.

FULLY CHARGED BATTERY VOLTAGE (NO LOAD)
12.6 Vdc minimum

Battery Storage

NOTICE Battery storage is critical for battery life. Regularly charging the battery during storage will prevent cell sulfation. Keeping the battery in vehicle for storage may lead to contacts degradation/corrosion and case damage if freezing occurs. A discharged battery will freeze and crack in areas where freezing conditions are experienced. Electrolyte leakage will damage surrounding parts. Always remove battery from vehicle for storage and regularly recharge it to keep an optimal condition.

Clean battery terminals and cable connections using a wire brush.

Apply a light coat of dielectric grease on terminals.

Clean battery casing using a solution of baking soda and water.

Rinse battery with clear water and dry well using a clean cloth.

Store battery in a cool dry place. Such conditions reduce self-discharging and keep fluid evaporation to a minimum. Keep battery away from dew, high moisture and direct sunlight.

Recharge frequency depends on battery condition and storage temperature. Maintain battery as per following table.

NOTE: The battery must always be stored in fully a charged state.

AMBIENT TEMPERATURE	CHARGING FREQUENCY
Below 16°C (60°F)	Every month
Above 16°C (60°F)	Every 2 weeks

Activation of a New Battery

Battery Initial Charging

NOTE: Since the batteries are factory activated, they never need to be activated using electrolyte container (acid packs). The electrolytes are already in the batteries.

1. Carefully read the *SAFETY WARNINGS* section before starting.
2. Remove battery from vehicle.
3. Place battery on a level surface.

4. Charge battery to bring it to a full state of charge.

- When using a constant current charger: Refer to the standard (STD) charging method indicated on the battery. Keep an eye on the voltmeter and battery to avoid overcharging.
- When using an automatic type taper charger: Check to make sure that the charger current (amps) is equal to or greater than the standard (STD) charging method indicated on the battery.



TYPICAL CHARGING METHOD LABEL
Some batteries may differ

5. Let stand for at least 2 hours.
6. Check battery voltage using a voltmeter.
7. Ensure that the battery voltage is 12.8 V or higher.

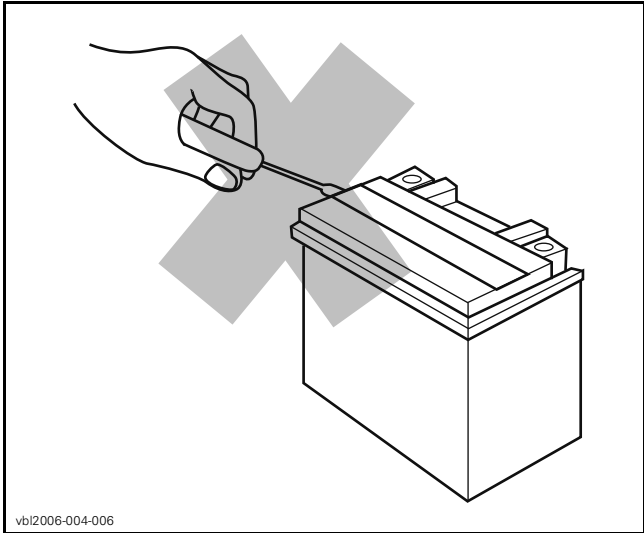
NOTE: Reading for a newly-charged battery should be 12.8 V or higher. If less, it needs additional charge.

8. Install battery on vehicle.

NOTICE Never remove the battery strip from caps or add electrolyte for the life of the battery.

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NEVER REMOVE BATTERY STRIP

Charging a Used Battery

WARNING

Always wear safety glasses and charge the battery in a ventilated area. Never charge or boost a battery while installed on a vehicle. Do not open the sealed caps during charging. Do not place battery near an open flame.

NOTICE If the battery becomes hot to the touch, stop charging and allow it to cool before continuing.

NOTE: Sealed VRLA batteries have an internal safety valve. If battery pressure increases due to overcharging, the valve opens to release excess pressure, preventing battery damage.

Carry out a battery *UNLOADED VOLTMETER TEST* as described in this subsection, then proceed as described here.

An automatic charger is the fastest and most convenient way for error-proof charging.

When using a constant current charger, charge battery according to the chart below.

Battery Voltage Below 12.8 V and Above 11.5 V

YTX20L-BS	TIME	CHARGE
STANDARD CHARGING (RECOMMENDED)	4 - 9 hours	2 A
QUICK CHARGING	50 minutes	10 A

Battery Voltage Below 11.5 V

A battery with a voltage below 11.5 V requires a special procedure to recharge. In charging an over discharged battery, its internal resistance may be too high to charge at a normal charging rate.

Set charger to the 10 A charging rate and monitor charging current for approximately 30 minutes. If there is no change in charging current or battery becomes abnormally hot, the battery is most likely at the end of its service life and should be replaced.

Battery Installation

1. Install the battery in the watercraft and secure it using retaining strap.

WARNING

Always connect battery cables in the specified order, RED (+) cable first, BLACK (-) cable last.

2. Connect RED (+) cable.
3. Connect BLACK (-) cable last.
4. Apply dielectric grease on battery posts.
5. Verify cable routing and attachments.
6. Install remaining removed components.

Battery maintenance

These batteries require little maintenance to perform perfectly. Follow this simple check list for optimum battery performance:

- Check voltage every 3 months using a voltmeter.
- Keep a battery fully charged to 100% (12.8 V or higher after standing 2 hours).
- Check and charge battery if the voltage drops below 12.5 V.
- Keep the battery top free of grime.
- Clean terminals and connectors if necessary.
- For storage, pull battery or disconnect battery cables.